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# THE MANUFACTURE OF VENEER



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# THE MANUFACTURE OF VENEER[1]

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## Abstract

Veneer and the methods commonly used to cut and dry it are described. The veneer industry and its products are also briefly discussed.

## Introduction

Wood has been cut into veneers for a long time. There are records showing that the Egyptians practiced the art of cutting and applying thin sheets of the finer woods probably 3,000 or more years ago (7),[3] and chests and other cabinet articles removed from their tombs bear striking testimony to the fact. Nevertheless, the use of veneer among the ancients appears to have been confined to ornamentations, inlaying, finishing carved surfaces, or bringing out the figure of wood, and its use did not progress beyond the ornamental stage until a very few decades ago.

While there is unmistakable evidence that veneer was used thousands of years ago, it is not so clear just how it was made in those early times. In all probability, however, it was laboriously produced by primitive methods of splitting, planing, and abrasion. In more modern times prior to about 1805, when a power-driven circular saw for the purpose was patented and put into operation in England, (1) veneer was cut by simply ripping thin sheets from a block with a hand saw. Shortly after the first power veneer saw was put into operation, a machine for slicing veneers was patented. This machine, although not entirely successful, demonstrated the feasibility of cutting veneer with a knife and served as the first step toward our present-day slicers and rotary lathes. It took about three-quarters of a

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[1]Report originally issued February 1924.

[2]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[3]Underlined numbers in parentheses refer to Literature Cited at the end of this report.

century, however, to develop a rotary lathe that would now be considered a success. During the past years many further improvements have been made in saw, slicer, and lathe equipment.

## Veneer Definition and Thicknesses

Veneer may be defined as thin layers or sheets of wood. It is produced on a lathe, a slicer, or a saw, and is commonly referred to as "rotary," "sliced," or "sawed" veneer, according to the manner of cutting. It may be used as a single ply or as a combination of plies bonded together to form plywood; or it may be glued to lumber or other core materials to form veneered products.

Veneer is cut in many thicknesses, ranging commonly from 1/40 to 5/16 inch. For special purposes it is cut as thick as 3/8 and as thin as 1/110 inch, or even less. Either the slicer or the rotary lathe will work down to thicknesses of 1/110 inch under favorable conditions, but it is impractical to saw veneer thinner than about 1/32 inch.

The large bulk of the softwood rotary veneer is cut in thicknesses of 3/16, 1/8, and 1/10 inch. Rotary hardwood veneers for plywood cores are cut more or less in thicknesses of 1/12, 1/10, 1/8, 3/16, and 1/4 inch, depending on the density of the wood and the type of plywood to be made. Common thicknesses for rotary-cut hardwood face veneers are 1/20, 1/24, and 1/28 inch. In the less valuable species, the face veneers may be cut as thick as the cores. Typical rotary-cut hardwood and softwood container-veneer thicknesses are 1/10, 1/8, 1/7, 1/6, 3/16, 7/32, 1/4, and 5/16 inch. Basket veneers are commonly cut 1/18 and 1/14 inch thick, but may be cut in other thicknesses up to 1/8 inch.

Sliced veneer cut on large slicers for use in plywood and furniture generally ranges from 1/32 to 1/16 inch thick. The most common sliced face-veneer thickness is 1/28 inch. Occasionally, some woods like mahogany are sliced as thin as 1/100 inch, and others like oak may sometimes be sliced as thick as 1/8 inch. Softwood container-veneer shooks sliced on special small slicers are cut to the same thicknesses as rotary-cut container veneers. The great bulk of sawed veneer is cut into thicknesses of 1/4 to 1/24 inch. The most common thickness is 1/24 inch.

## Preparation of Wood for Cutting

Logs intended for veneer cutting are generally cut in the same lengths as sawmill logs. In some cases, however, special lengths are considered desirable in order to allow for a certain length of finished product plus certain trim reductions. In Douglas-fir, for example, the 34-foot length is popular, because it permits the cutting of four bolts, each 8-1/2 feet long. This length permits spurring ends in the lathe to a uniform length of 100 inches, and trimming of the finished plywood panel to 96 inches.

Veneer logs should not be allowed to dry out before cutting into veneer by the rotary or slicing process, for dry wood cannot be properly knite-cut.

For cutting on a lathe or slicer the wood of some species should be heated to soften it (4). Wood that is hard should be heated to higher temperatures, whereas softer woods may be heated to a lower temperature or cut at room temperature. For example, oak cuts well if heated to 160° F. or up to 200° F., yellow birch at 140° F. to 170° F., gum at 130° F. to 150° F., yellow-poplar at 90° F. to 120° F., and very soft woods such as cottonwood and basswood may be cut satisfactorily at room temperatures. Steam or hot water is used for heating the wood. The heating medium and the heating schedules should be adapted to the species and size of timbers to be heated. Usually blocks are heated for 1 or 2 days, except in the case of fancy, highly figured woods, which may be heated for as long as a week.

For rotary cutting, the bolts are generally heated with the bark on, because heating facilitates the removal of the bark with hand tools. Wood to be sliced is usually first cut into "flitches," which are portions of logs cut out, usually for the purpose of getting a certain figure or grain pattern. For sawing, the wood need not be heated, or is a high moisture content essential to good cutting. Before being mounted on the veneer saw, logs are sawed into flitches in order that the saw cut may bring out the desired grain pattern in the veneer.

## Rotary Cutting

Lathes are all made on the same general plan and cut the veneer in the same way. The differences exist principally in the framework and in the manner in which the log is inserted in the machine. The typical lathe (fig. 1) consists of a heavy steel bed on which is mounted at each end a framework for the support of the bearing spindles. The spindles are equipped with chucks for

gripping the log and can be moved in or out as necessary. The log is hoisted by power and inserted in the lathe from either the front or the top. The knife and pressure bar extend the full length of the machine, on the inside of the frame.

The cutting is accomplished by revolving the log against the knife, with the veneer being peeled off in a continuous sheet very much like unrolling paper. The wood is compressed by a pressure bar or nosebar (fig. 2) immediately ahead of the knife to prevent excessive checking of the veneer. The knife-and-nosebar carriage is slowly moved into the log by an automatic geared arrangement, adjustable for any thickness of veneer. As the veneer comes from the lathe it is received on a reel, conveyor, or table. Then it is clipped to eliminate defects and to bring the sheets to the desired dimensions.

The quality of the veneer produced on a lathe depends on the quality of the logs used, the skill of the operator, the condition and adjustment of the lathe, and the proper conditioning of the wood for cutting. All knife-cut veneer, whether rotary-cut or sliced, has a firm or tight side and a loose or open side. The degree to which the pith side is broken or the severity of the "lathe checks" in it, depends on the thickness of the veneer and the quality of the cutting. On veneer 1/32-inch thick, for example, lathe checks may not be detectable by eye, whereas on 1/8-inch veneer they may be clearly visible. In face veneers it is important that the severity of the lathe checks be kept at a minimum and, in gluing, the tight side should preferably be toward the outside, as it is less likely to show defects in finishing. Other defects that may occur in cutting are: Non-uniformity of thickness in the sheets, corrugations because of vibrations in the machine, roughness, scratches, torn grain, and shelling or crushing because of over-compression (3).

Rotary-cut veneer is usually flat-grained because the cut is generally tangent to the annual rings. In irregularly shaped logs of certain species, however, a considerable amount of figure may be obtained. It is possible to produce other grain patterns in the rotary lathe with the aid of a metal "stay log" or carrier that is mounted between the chucks, to which segments of logs are bolted in such a manner as to bring out the desired grain pattern. The most common mounting methods are the "half round," in which the log is sawed longitudinally into halves and the sawed surfaces are mounted against the stay log, and the "back cut," in which the bark side of a half-log is mounted against the stay log. By this method the knife cuts a succession of slices of veneer from the face of the segment as the stay log revolves, rather than a continuous sheet. Recently species like oak have been rift cut on lathes equipped with stay logs that can be shifted hydraulically.

Most lathes do not operate at speeds greater than 50 to 60 revolutions per minute. The speed at which the band of veneer emerges from the machine is ordinarily 200 to 400 feet per minute for hardwood logs, and up to 1,000 feet per minute for large softwood logs, with the limiting speed generally depending upon facilities for removing the veneer from the lathe.

## Slicing

Several types of veneer slicers are in use, but the principle of operation in all is practically the same. In most domestic models the flitch moves downward over the knife to cut the veneer (fig. 3). In some designs, however, the knife is moved by power and the flitch moves only to regulate the thickness of cut.

In operating a slicer with a stationary knife, the flitch, after it has been properly heated, is held to a heavy steel frame, called the "flitch table," by dogs. The dogs grip the flitch top and bottom and hold it firm. The flitch table is given an oblique up and down movement on slides which support it. On each down stroke the flitch is drawn against the edge of the knife, which is held in rigid alinement with a pressure bar, and a slice of veneer is thus cut off. On the up motion the knife automatically recedes, so that there is no interference with the flitch, and the knife then automatically advances to give the thickness of the veneer and is ready for the next cut. The veneer passes through a slot between the knife and the pressure bar. It is turned over by hand, and each successive slice is piled in order. In this manner the veneer slices are kept in the same relative position as in the solid flitch, and the veneer of each flitch can be kept by itself and sold entire, which is usually the case with face stock.

For the most part, veneer produced on a slicer is in long, narrow strips. The material may be edge-grained (quarter sliced), flat-grained (plain sliced), or rift-grained, depending on the manner in which the flitch was mounted with respect to the knife.

Most large slicers operate at speeds of 35 to 50 strokes per minute, although machines have been built to operate at 100 strokes per minute. Small slicers of somewhat different design, used to cut box shooks and battery separators, operate at speeds up to 240 strokes per minute.

## Sawing

The blade of the veneer saw is made up of segments that are affixed to the circumference of a central disk. The segmental form has been found the most practical one for repair and replacement. The disk is thick in the center and has a gradual taper outward, which makes for strength, rigidity, and uniform thin cutting. The saw usually makes a kerf about 1/20 inch thick. The sawing process, though simple, is wasteful of material and time and, therefore, expensive. It is used chiefly in the cutting of certain high-grade finish and furniture woods into veneer.

The flitches are fastened to a steel table by screw dogs. The table is mounted on a saw carriage, which is power-driven backward and forward. The cut veneer is drawn away from the saw by a stationary bevel block with vertical edge, falls face down on the platform, and is thus automatically piled, with the pieces assuming the same position they occupied in the flitch. The feed in the modern machines is automatic, and sets the carriage forward the thickness of the veneer at each draw-back. It can be regulated for various thicknesses of veneer.

Most of the veneer cut by the saw is used for "face stock" in veneered panels. With a 1/20-inch thickness, which is common, a little less than one-half the flitch is converted into veneers, with the remainder being sawdust and "dog board," which is the portion of the flitch by which it is clamped to the saw carriage and which therefore cannot be converted.

Sawed veneer is different from that cut by other processes, discussed above, in that its quality and appearance on both sides are the same. This enables either side to be turned out in matching face stock for figure in the manufacture of panels.

## Drying Veneer

To a limited extent veneer may be used wet as it comes from the lathe, but for use in the bulk of products it must first be dried. Ordinarily, the drying is taken care of at the cutting plant, except in the softwood plants on the West Coast, where the veneer is dried at the plywood plant.

A number of methods are used in drying veneer, of which mechanical drying (fig. 4) in a roller, endless-belt, or hot-plate dryer is most common. In these dryers, the veneer is subjected to high temperatures and is held relatively flat. The drying time is usually less than 45 minutes,

but varies with the thickness and kind of wood. In some plants veneer is dried at room temperature by suspending it on special holders from the ceiling or arranging it in racks. This requires more time than do the high-temperature methods, and the veneer is usually not held flat during the drying, but the conditions are better for getting maximum shrinkage of the stock. Another method is that of putting the veneer in racks and frames and drying it in a special kiln equipped with steam coils and blower. In still other instances veneer, especially the thicker stock, is stickered as is lumber and dried in lumber kilns. The hot-plate type of mechanical dryer is most frequently used for bringing the material from approximately an air-dry condition to a low moisture content just before it is glued.

## Waste in Veneer Manufacture

The waste entailed in the production of veneer by any of the three methods is considerable. In rotary cutting and slicing hardwood logs, less than half of the log volume may be recovered in the form of veneer, whereas from larger softwood logs more than half is generally recovered (2). However, the proportion of the high-grade content of logs converted into veneer by rotary cutting compares favorably with that produced as lumber. In addition, veneer and the plywood made from it are generally used in thinner sheets than lumber for similar applications. The finished veneer or plywood products are generally of such size and quality as to be ready for final application without much trimming and resurfacing, whereas lumber often requires a great deal of trimming to remove defects, resurfacing, and the like by the consumer.

## General Description of the Industry and Its Products

In 1961 about 3.7 billion board feet of Douglas-fir and other softwood logs were cut into veneer on the West Coast (5). These logs were used by about 150 mills, employing almost exclusively the rotary cutting process. Most lathes in these mills cut veneer bolts of 8- and 10-foot lengths into veneer. The veneer was used primarily for the production of plywood for structural and other purposes, which resulted in the production of more than 8 billion square feet of plywood 3/8 inch thick, or its equivalent in other thicknesses.

The hardwood veneer industry, which is widespread throughout the eastern half of the United States, consumed about 1 billion board feet of logs in

1961 (5). The greatest concentration of productive capacity is in the Southern and Southeastern States, followed by the Lake and Central States, and then by the Northeast and Middle-Atlantic States. It is estimated that between 600 and 700 mills produce veneer in the eastern United States on 800 to 900 lathes. These lathes vary in length from 26 to 100 inches, with the intermediate lengths being the most common. The species used in greatest volume are sweetgum, water tupelo, and black tupelo. Other species used are birch, maple, cottonwood, yellow-poplar, magnolia, sycamore, beech, elm, ash, white and red oak, basswood, mahogany, walnut, and other hardwoods. Some southern yellow pine, a softwood, is also cut.

More than half of the hardwood veneer produced is used for furniture and plywood manufacture. Smaller quantities are used for millwork, musical instruments, radios, chairs and seats, refrigerators, vehicles, cars, sewing machines, air-craft, trunks, and toys. The remainder, or about one-third, is used, largely as single ply, for containers, including boxes, baskets, crates, cases, drums, chests, barrels, hampers, and hoops, and for many miscellaneous items, such as matches and surgical and picnic supplies. Market shipment of veneer core hardwood plywood was 792 million square feet and lumber core 58 million square feet surface measure during 1960. This does not include container and packaging type plywood (6).

The veneer-slicing industry is more highly specialized and the veneer produced is generally more expensive than that produced by the rotary process. There are probably not more than 100 large slicers scattered through the hardwood industry, and many of them are in the Central States. The principal woods cut are mahogany, walnut, and oak, but others, including many imported woods, are sliced whenever the occasion demands. Much of this veneer is consumed by the furniture industry. Small, fast shook slicers are used in the West Coast industry for slicing Douglas-fir and other softwoods into container and battery-separator veneers.

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Figure 1.--A lathe for producing rotary-cut veneer. The heavy bar ahead of the veneer bolt supports the nosebar and immediately behind it is the knife.

Z M 86641 F

Figure 2.--Detail of veneer-cutting operation on a rotary lathe, much enlarged. The pointed part in the center is the knife edge, with the veneer moving off to the left. The veneer contains "lathe checks" on its lower surface. Opposite the knife edge is the nosebar, compressing the wood sufficiently so that water is flowing from it during cutting.

Z M 78089 F

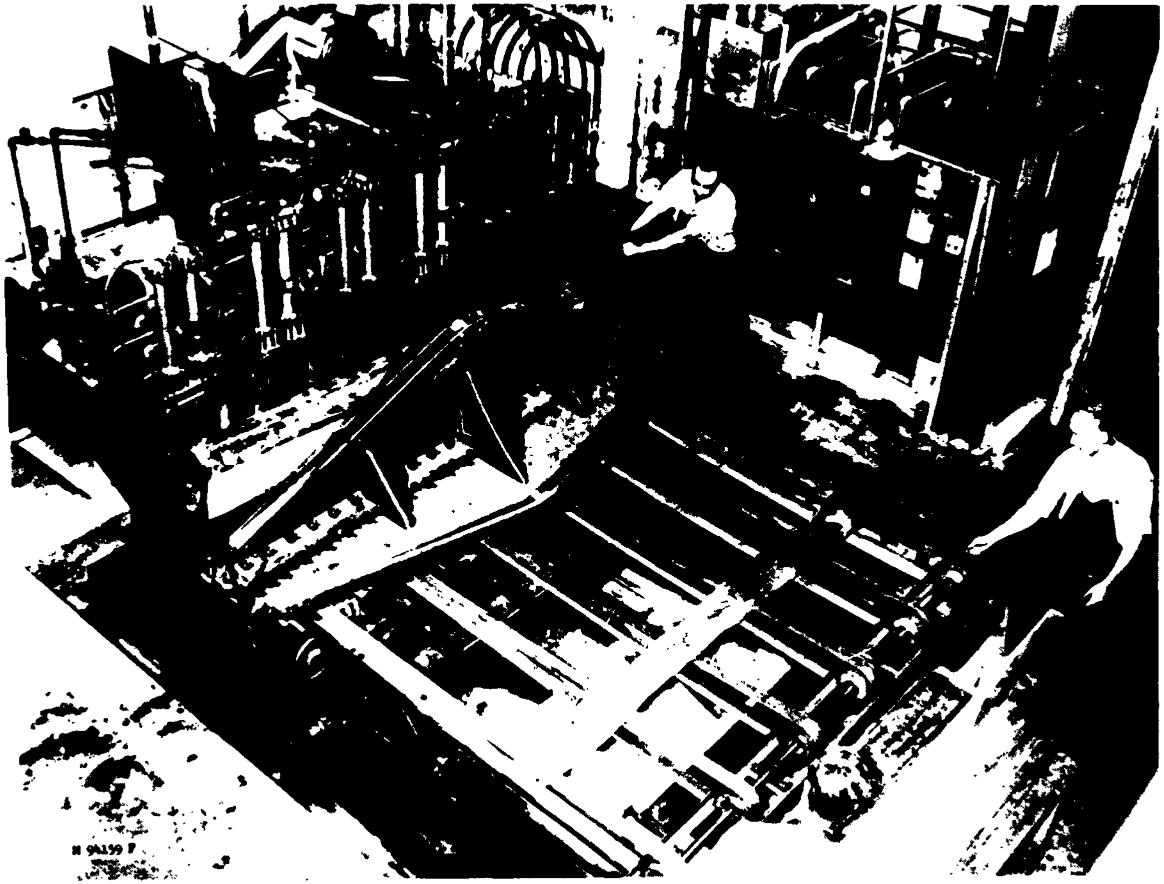

Figure 3.--A veneer slicer in operation.

Z M 94159 F

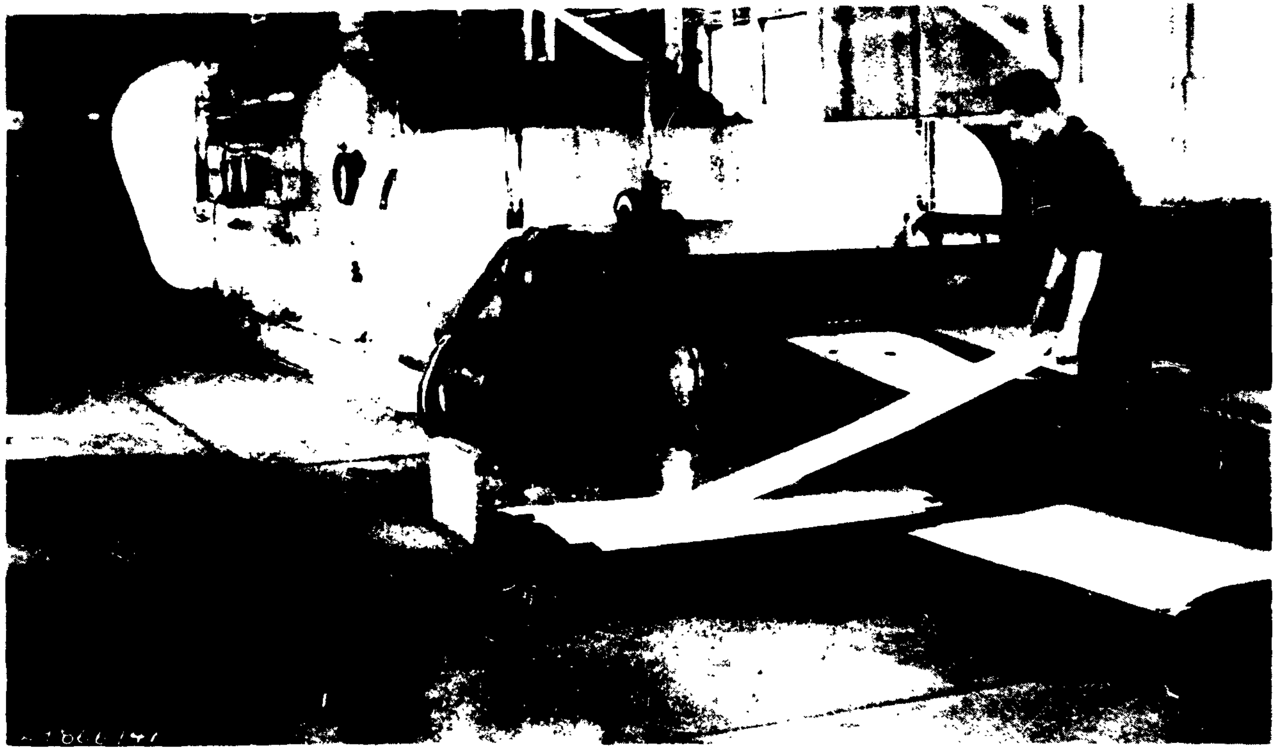

Figure 4.--A Laboratory model mechanical veneer dryer, dry end. The veneer passes through the drying tunnel between sets of rollers. Notice the large ducts for recirculating the heated air.

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FPL FILING SYSTEM DESIGNATION--V-3

U.S. Forest Products Laboratory.
The manufacture of veneer. 5th ed., rev. Madison, Wis., The ... Laboratory, 1962. 11 p., illus. (F.P.L. rpt. no. 285)

Veneer and the methods commonly used to cut and dry it are described. The veneer industry and its products are also briefly discussed.

U.S. Forest Products Laboratory.
The manufacture of veneer. 5th ed., rev. Madison, Wis., The ... Laboratory, 1962. 11 p., illus. (F.P.L. rpt. no. 285)

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